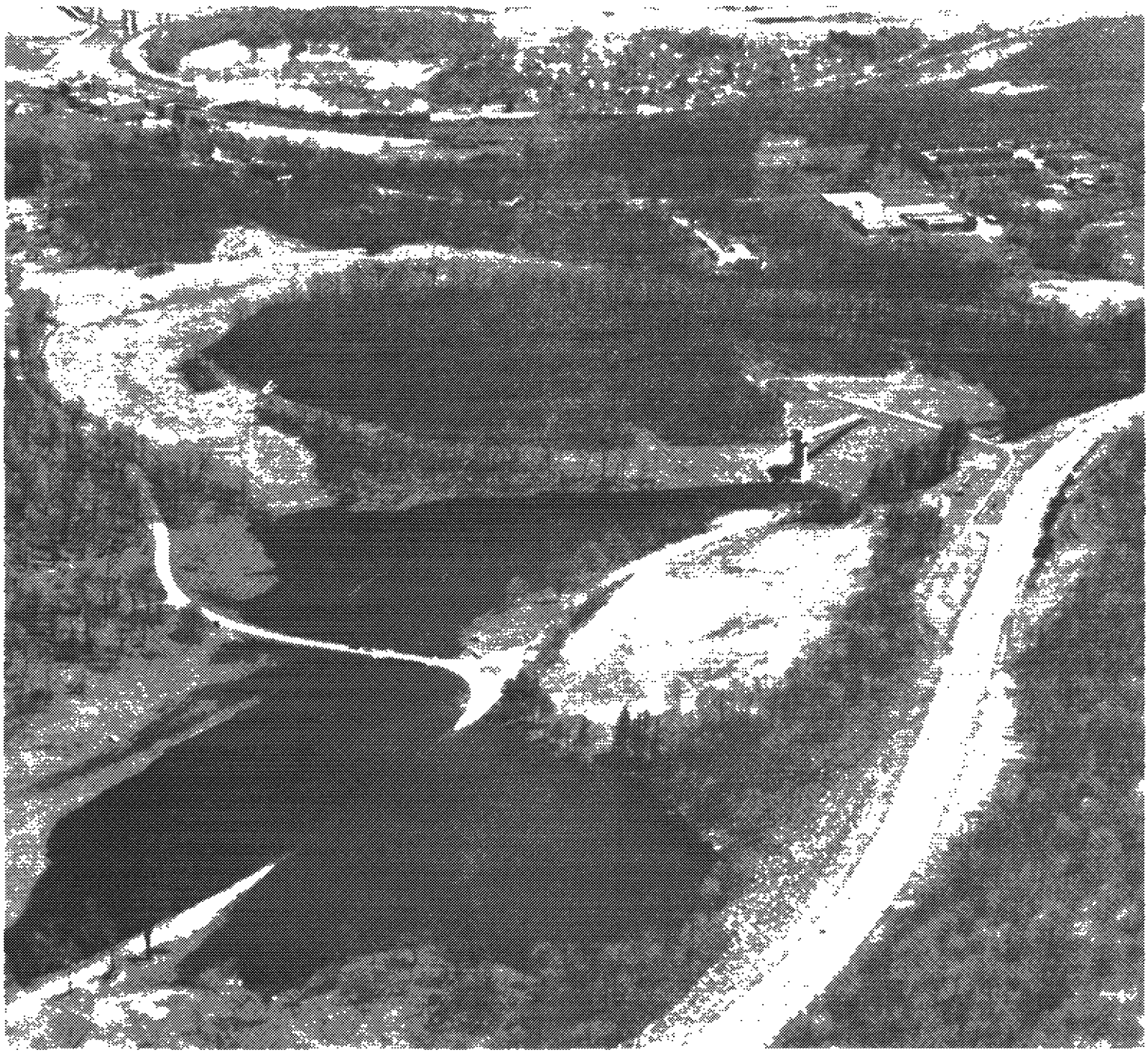
US Army Corps
of Engineers
New England Division

Drought Contingency Storage Plan

MARCH 1985

Hop Brook Lake, Connecticut



HOUSATONIC RIVER BASIN
NAUGATUCK RIVER WATERSHED

DROUGHT CONTINGENCY STORAGE PLAN
HOP BROOK LAKE, CONNECTICUT

MARCH 1985

NEW ENGLAND DIVISION, CORPS OF ENGINEER
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

SYLLABUS

A drought contingency storage plan was studied for Hop Brook Lake in an effort to be responsive to public needs during drought situations. It was determined that water could be temporarily stored to an elevation of 312 feet NGVD, 2 feet above the permanent pool, providing up to approximately 166 acre-feet (54 million gallons) of reservoir storage for drought emergency purposes.

An evaluation of the potential effects of this plan has revealed no major adverse impacts at this time. However, the water at Hop Brook Lake is of basically poor quality for water supply. It would be suitable for fire-fighting or irrigation.

DROUGHT CONTINGENCY PLAN
HOP BROOK LAKE

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DROUGHT CONTINGENCY STORAGE PLAN
HOP BROOK LAKE

1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency storage plan of operation for Hop Brook Lake, that would be responsive to public needs during drought periods and identify possible constraints. This plan was based on preliminary studies utilizing readily available information. Included are a description of existing water supply conditions, the potential for reallocation of reservoir storage within specified limits, evaluation of water quality, discussion of impacts on other project purposes, the effects on the environment and a summary and conclusions.

2. AUTHORIZATION

The authority for the preparation of drought contingency plans is contained in ER 1110-2-1941 which provides that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public need. Drought contingency storage plans will be developed on a regional, basin-wide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Hop Brook Lake was authorized by the Flood Control Act of 14 July 1960 (Public Law 645, 86th Congress). The lake has been authorized as a flood control project which includes a permanent conservation pool. In addition, section 4 of the Flood Control Act of 22 December 1944 (Public Law 534, 78th Congress) authorized the development and use of reservoir areas for public recreation and other purposes.

4. PROJECT DESCRIPTION

Hop Brook Lake, completed in 1968, is a dual purpose flood control and recreation project, located on Hop Brook, in the towns of Waterbury, Naugatuck and Middlebury, Connecticut. A map of the Housatonic River basin is shown on plate 1, with a map of the Naugatuck River watershed shown on plate 2.

The project contains storage for flood control and

recreation. The 18-foot deep recreation pool (elev. 310 feet NGVD) contains 120 acre feet equal to 0.12 inch of runoff. The flood control storage contains 6,850 acre-feet which equals 7.8 inches of runoff from the 16.4 square miles of drainage area. A capacity table is shown on plate 3, and a summary of pertinent data at Hop Brook Lake is listed on plate 4.

The physical components of the Hop Brook project consist of a rolled earthfill and rock-faced dam, outlet works, a chute spillway, and a small recreation pool. The outlet works, located along the left bank, consist of an intake channel, a concrete weir to maintain the permanent recreation pool, a control tower, a 425-foot long,3 foot wide by 4 foot high rectangular conduit, a stilling basin and an outlet channel. The discharge through the conduit is controlled by two 3 x 4-foot slide gates, with an intake channel weir located upstream of gate 1. The six stoplog openings of the control weir are 4 feet deep for flexibility in maintaining the level of the permanent pool.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. The recreation pool is approximately 18 feet deep and is maintained by a concrete weir and stoplog structure upstream of gate 1. The gate settings are 2.0′-0.1′. During the freezing season, gate 1, the exposed flood control gate, is operated daily to prevent freezing.

b. Flood Periods . Hop Brook is operated in concert with other projects in the Housatonic River basin to reduce downstream flooding along the Naugatuck and Housatonic Rivers. Operations for floods may be considered in three phases: Phase I - appraisal of storm and river conditions during development of a flood, phase II - flow regulation and storage of flood runoff at the reservoir, and phase III - emptying the reservoir during recession of the flood. The regulation procedures are detailed in the Master Water Control Manual for the Housatonic River Basin.

c. Regulating Constraints

(1) Minimum Releases. A minimum release of 10 to 20 cfs (6.5 to 13 mgd) is maintained during periods of flood regulation in order to sustain downstream fish life.

(2) Maximum Releases. The maximum nondamaging discharge immediately downstream of Hop Brook Lake is approximately 550 cfs.

6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 28 New England Division flood control dams, and continually monitors rainfall, snow cover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corps Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with other Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. The area of concern are those communities in southwestern Connecticut in the vicinity of Hop Brook Lake. These communities encompass portions of Fairfield, Hartford, Litchfield, and New Haven Counties. Table 1 contains information about public water suppliers in the area which have a service population greater than 1,000. Data presented for the major water suppliers include towns served, estimated service population, actual water production for calendar 1980 or 1981, and the safe yield for active water supply sources. The table has been formulated using data primarily provided by the State of Connecticut Department of Environmental Protection, supplement3ed with information from the Housatonic River Basin Urban Study, published by the Corps of Engineers in September 1982. In those instances where data provided by the State was incomplete, information from the Corps Housatonic River Basin Study was used. Any remaining missing information was not developed as such efforts were considered beyond the level of detail required for this study.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of Hop Brook Lake that could benefit from storage at the project, and to present the data in a manner portraying existing water supply conditions. Projections of future demands were not developed because this study addresses only modifications in the operational procedures at Hop Brook Lake in order to provide storage for water supply purposes when drought conditions exist, and not to meet normal water supply demands at some future date.

c. Southwestern Connecticut Water Supply. Information pertaining to the larger water suppliers in the

vicinity of Hop Brook Lake in southwestern Connecticut are presented in table 1. An analysis as to whether existing sources can provide adequate supplies during drought conditions was not performed. The information has been accumulated to present a summary of the existing water supply conditions pertaining to major water suppliers in southwestern Connecticut.

d. Population Projections. Population projections for communities in the study area are given in table 2 to show population trends for each community potentially affected by a prolonged dry period. The projections were taken from Population Projections for Connecticut Municipalities and Regions to the Year 2000, published by the State of Connecticut Office of Policy and Management. This information is presented to indicate potential future growth in southwestern Connecticut.

8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local communities in need. In addition, guidance contained in ER 1110-2-1941 directs field offices to determine the short-term water supply capability of existing Corps reservoirs that would be functional under existing authorities. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purposes.

b. Drought Contingency Storage. It has been determined that a portion of the existing storage at Hop Brook could be utilized for emergency drought contingency storage without having an impact on the project's flood control and recreation functions. Storage could be made available to a pool elevation of approximately 312 feet NGVD (20-foot stage). This represents a volume of about 166 acre-feet, equivalent to 54 mg or approximately 2 percent of the reservoir storage. This volume is comprised of 120 acre-feet of permanent storage and 46 acre-feet of flood control storage. The 46 acre-feet represents an infringement of about 0.06 inches of runoff on the flood control storage.

Based on an all-season low flow duration analysis using 13 years of flow records for the gaging station on Hop Brook at Naugatuck, Connecticut, it was determined that during a

TABLE 1
SOUTHWESTERN CONNECTICUT - MAJOR WATER SUPPLIERS

Company	Towns Served	Estimated Population Served	Source of Supply GW/SW	Year	Water Production Surface (MG)	Water Production Ground (MG)	Average Daily Demand (MGD)	Safe Yield Active Sources SW (MGD)	Safe Yield Active Sources GW (MGD)
Ansonia-Derby Water Co.	Ansonia Derby	20,500 11,500	GW/SW	1981	995.9	808.5	4.94	3.10	10.70
Bridgeport Hydraulic Co.	Beacon Falls Monroe Seymour Shelton	1,834 4,311 8,496 22,860	GW/SW	1981	6,872.0	3,297.8	27.86[2]	7.40	26.58
Fairfield Hills Hospital	Newtown	3,200	GW	1981		127.1	0.35		1.84
Heritage Village Water Co.	Middlebury Oxford Southbury	25 50 5,500	GW	1980		63.3	0.17		.90
Indian Hill WC, Ind. Field Co.	Naugatuck	1,389	GW	1980		352.7	0.97		.35
Naugatuck Div., Conn. Water Co.	Beacon Falls Naugatuck Waterbury	200 18,851 315	GW/SW	1980	1,163.8	49.5	3.32	4.77	-
Newtown Water Co.	Newtown	3,200	GW	1981		120.3	0.33		-
Plainville Water Co.	Bristol Plainville Southington	45 16,351 485	GW	1980		905.7	2.48		2.95
Southbury Training School	Southbury	2,450	GW	1980		118.6[1]	0.32		0.66
South Central Conn. Regional Water Auth.	Cheshire	17,800	GW/SW	1981	-	632.6	-	-	3.36
Southington Water Works Dept.	Cheshire	248	GW/SW	1980	278.7	995.6	3.49	-	3.03
Terryville Div., Conn. Water Co.	Plymouth	5,642	GW/SW	1980	5.9	155.6	0.44	-	0.74
Thomaston Div., Conn. Water Co.	Thomaston	2,831	GW/SW	1980	110.1	71.8	0.50	0.40	0.11
Waterbury Water Bureau	Waterbury	103,300	SW	1980	7,823.0		21.43	70.50	
Watertown Fire Dist.	Watertown	6,600	GW/SW	1980	0.0	301.5	0.83	1.39	12.80
Woodbury Water Co.	Woodbury	1,700	GW	1980		59.6	0.16		0.11

[1]Information taken from Housatonic River Basin Urban Study, U.S. Army Corps of Engineers, September 1982. All other information provided by the State of Connecticut, Department of Environmental Protection, Natural Resources Center.

[2]Demand determined by withdrawals from supply sources in study area communities. A large portion of this demand actually occurs in communities outside the study area.

TABLE 2

POPULATION PROJECTIONS
COMMUNITIES NEAR HOP BOOK LAKE

Town	Actual 1980	1985	1990	1995	2000	Percent Change 1980-2000
Ansonia	19,039	19,210	19,260	19,270	19,220	1.0
Beacon Falls	3,995	4,150	4,250	4,350	4,400	10.1
Bethany	4,330	4,480	4,630	4,780	4,900	13.2
Bethlehem	2,573	2,710	2,850	2,980	3,120	21.3
Cheshire	21,788	23,290	24,790	25,790	26,790	23.0
Derby	12,346	12,540	12,810	13,010	13,110	6.2
Middlebury	5,995	6,080	6,200	6,310	6,380	6.4
Monroe	14,010	14,920	15,980	16,950	17,610	25.7
Naugatuck	26,456	27,150	28,040	28,900	29,640	12.0
Oxford	6,634	7,210	7,680	8,140	8,540	28.7
Plymouth	10,732	11,080	11,380	11,600	11,730	9.3
Prospect	6,807	6,790	6,810	6,760	6,630	-2.6
Seymour	13,434	14,270	15,340	16,540	17,640	31.3
Shelton	31,314	32,770	34,320	35,600	36,300	15.9
Southbury	14,156	15,060	15,760	16,460	17,260	22.6
Southington	36,879	37,880	39,380	40,580	41,580	12.8
Thomaston	6,276	6,390	6,570	6,730	6,780	8.0
Waterbury	103,266	102,760	103,660	104,530	105,410	2.1
Watertown	19,489	19,790	20,090	20,390	20,690	6.2
Walcott	13,008	13,220	13,650	13,940	13,990	7.6
Woodbridge	7,761	7,860	7,960	8,060	8,110	4.5
Woodbury	6,942	7,110	7,220	7,280	7,260	4.6
TOTAL	387,230	396,630	408,630	418,950	427,090	10.3

10-year frequency drought, the volume of runoff could: a) fill the reservoir from elevation 310 to 312 feet NGVD in a 20-day summer period provided no releases were made from the dam or, b) fill the reservoir to elevation 312 in a 42-day period if a continuing release of approximately 2 cfs (0.1 cfs/sq.mi.) were maintained. However, the reservoir could be filled to elevation 312 in about a 10-day period in May while continuously releasing 10 cfs. The stored water could be used for municipal supply with proper treatment, either by drawing directly from the reservoir or releasing for downstream withdrawal. Drought contingency storage versus flow duration at Hop Brook Lake is shown graphically on plate 5.

c. Effects of Regulated Flows. The curtailment of flows from Hop Brook Lake during the drought emergency could adversely impact on the flowage rights of downstream riparian users. At this time, however, it is not possible to review all of the various drought emergency situations that could occur, nor is it within the scope of this report to identify all those with water rights. It is important to note that when a specific drought emergency does occur, the legal implications would have to be weighed.

9. WATER QUALITY EVALUATION

a. Water Quality Classification. The waters of Hop Brook Lake are rated class B by the State of Connecticut. Class B waters are suitable for bathing, other recreational purposes, agricultural uses, certain industrial processes and cooling. These waters have high aesthetic value and provide excellent fish and wildlife habitat. The project's watershed includes six streams, Hop Brook, Welton Brook, Wooster Brook, Long Swamp Brook, Goat Brook and Meshaddock Brook. Water quality conditions vary among these streams: Meshaddock Brook is the cleanest, having characteristics of a natural trout reproducing stream; Welton and Wooster Brooks are the most polluted due to intermittent overflows of sewage pumping stations located on their banks.

Technical requirements for class B waters include a minimum dissolved oxygen concentration of not less than 5 mg/l at any time, pH in the range of 6.5 to 8.0 standard units, coliform bacteria not to exceed a log mean of 200 per 100 milliliters nor shall 10 percent of the samples exceed 400 per 100 milliliters, and a maximum turbidity level of 10 JTU's (for cold water fisheries). Taste and odor should not be in such concentrations that impair class B purposes or impart taste and odor to edible fish.

b. Existing Water Quality. In general, the water quality of Hop Brook Lake should be rated poor when considering the lake as a water supply. This is due to the history of intermittent high coliform counts and algae bloom conditions which have been measured.

The high coliform counts generally result from tributary inflows although use of the public beach may increase the overall levels. Because of these high counts, the beach has been closed on a number of occasions.

Prior to extensive dredging which took place in the winter of 1979-1980, algae blooms were a common occurrence. Since 1980, the number of severe algae blooms have decreased but still occur; the most recent resulting in the draining of the pool in August 1983. Runoff from upstream swamp areas and the intermittent pumping stations overflows may be the cause of the majority of the nutrient loadings, however, there is reason to believe that phosphorus releases from the bottom sediments caused by the lake's long hydraulic detention time also aggravate the problem. The hydraulic residence time of the lake ranges from 1 to 4 weeks during average summer flows to almost complete stagnation during extreme low summer flows.

In addition, there is intermittent violations for minimum and maximum pH, turbidity, odor and color. These violations are not health problems but are undesirable in a water supply. Unacceptably low pH levels promote corrosion. High levels of turbidity can interfere with the chlorination process during treatment. Malodorous and highly colored waters are unappealing to water consumers. Intermittent algae blooms bring about the undesirable pH, turbidity, and odor levels. Natural watershed conditions cause high color concentrations. Most of these objectionable parameters can be reduced by standard treatment processes; however, advanced treatment may be required to remove taste and odor.

Water quality conditions for which there are no numerical state standards but are of possible concern in a public water supply include high iron and mercury levels. While not health hazards in water, elevated levels of iron can cause laundry-staining problems and the development of growths in plumbing fixtures. Findings of detectable concentrations of mercury are very rare and are probably naturally occurring. Due to its infrequency, however, it should not be a real cause for concern. These high metal levels can be reduced by standard treatment processes.

c. Water Quality Requirements for Drought Storage. There are two requirements to be met. The waters must meet

state standards for surface waters and must be of a quality appropriate for the water supply users. Water that meets class B criteria in Connecticut can be made usable for public water supply with standard treatment processes. The water quality required for industrial water supply depends on the industrial process involved. The water at Hop Brook Lake would always be of a quality suitable for fire-fighting or irrigation.

d. Effects of Drought Storage. Increasing the storage at Hop Brook Lake for drought relief will not affect the existing poor water quality. The proposed depth increase of 2 feet will flood on additional 4 acres of land. While increases in the decay of organic materials and, consequently, nutrient levels are likely, the present quality of the water will not be significantly changed. Current swimming, boating and fishing practices will not be adversely affected.

Raising the pool 2 feet would also cause slight increases in turbidity and sedimentation. The death of vegetation in newly inundated areas would loosen the soil and accelerate erosion when the pool is lowered. Most of the eroded soil would settle in the lake, but some would be discharged downstream. This increased erosion and sedimentation will not affect the suitability of the water for water supply or recreation.

e. Water Quality Conclusions. The water at Hop Brook Lake is of basically poor quality for water supply. As a eutrophic impoundment, the lake will have to be treated for fluctuating pH levels, heavy metals, color, taste, odor, turbidity and fecal coliforms before it is acceptable as a potable water supply. Most of these pollutants can be treated by standard processes; however, the removal of taste and odor may require treatment with activated carbon. No treatment will be necessary for the water to be adequate for fire-fighting, irrigation, or some industrial processes. Increasing the pool elevation by 2 feet to provide extra storage will not significantly change the existing poor quality of the lake. The reservoir will remain suitable for boating, swimming, and fishing.

10. DISCUSSION OF IMPACTS

a. General. Any action resulting in a temporary change of a reservoir's storage volume may have impacts on other project purposes which must be evaluated before a storage reallocation plan can be implemented. An evaluation has been made of the impacts resulting from drought contingency storage on the flood control purpose

of this project. Effects on recreation, sedimentation and the aquatic and terrestrial environments as well as the historic and archaeological resources are also discussed in the following paragraphs. Because of the minimal level of effort afforded this study, certain environmental concerns may require further consideration prior to project implementation.

b. Flood Control. A review of the regulation procedures at Hop Brook Lake was undertaken to determine the volume of water that could be made available for drought contingency purposes. The water would be stored by temporarily utilizing existing flood control storage. It is recognized that major floods occur in every season of the year, thus any use of flood control storage would be continually monitored to insure that there would be no adverse impacts on downstream flood protection.

At Hop Brook the maximum pool level for drought contingency storage would be elevation 312 feet , a two foot increase above the normal recreation pool. This increase represents an infringement on the flood control storage of about 0.06 inches of runoff or approximately two percent of the total flood storage capacity. This loss of storage is within acceptable limits established by the Corps of Engineers.

c. Recreation. The additional two feet of water will partially flood the existing beach and will require the temporary relocation of the six foot deep swimming area buoys surrounding the beach. The access to the beach as well as other recreational facilities will not be affected.

d. Project Operations. The weir upstream of gate 1 is designed to permit raising the recreational pool an additional two feet, and thus the proposed drought contingency storage could be accomplished through a minimum of Corps manpower. Any additional operation and maintenance costs as well as possible restoration costs necessary should shoreline damage occur (although expected to be minimal) must be borne by the user.

e. Effects on the Aquatic Ecosystem. The aquatic environment of the project area is located along Hop Brook in the Naugatuck River watershed. Tributaries to Hop Brook within the project area include Wooster Brook, Welton Brook, and Meshaddock Brook.

The permanent conservation pool maintained behind the dam has a surface area of 21 acres, and a maximum

depth of about 40 feet. Due to low flow conditions during dry summer months, Hop Brook Lake has frequently suffered from turbidity, high water temperatures, oxygen depletion and pollution from upstream sources,and occasional severe algae blooms. To benefit water quality and improve conditions for the cold water fish population, in 1978 through 1980 the lake was deepened from a maximum of 18 feet to about 40 feet.

A fish sampling conducted in July 1980 produced the following species in the inlet area to Hop Brook Lake: brown trout, johnny darter, white sucker, common shiner, blacknose dace, redfin pickerel, smallmouth bass, crayfish and bluegill. Personal interviews of fishermen conducted in 1979 indicated a distinct preference for trout. Raising the pool level by two feet would have little if any impact on the cold water fishery as it is already a put-and-take resource. The warm water fishery may benefit from the increased pool size but a detailed analysis of actual impacts will be required prior to project implementation.

During a drought emergency, restriction of flow from Hop Brook Lake could effect downstream aquatic habitat. The amount of flow to be released has not been determined, but could vary from no discharge in the worst case to as much as 10 cfs in less critical situations. The loss of flow would be detrimental to downstream fish, but the impact would have to be weighed against the degree of drought emergency. Further investigation of possible impacts would need to be a part of any decision to pursue drought contingency storage at the project.

There are no known endangered aquatic species present in the project area.

f. Effects on the Terrestrial Environment.

The lands surrounding Hop Brook Lake are predominately forest covered. The trees are typically small to medium in size and in thin stands, indicating secondary growth. Vegetation bordering the lake is dominated by red maple, black cherry and occasional American hornbeam and American elm. Much of the lake shoreline is open meadow or mown lawn maintained for public recreation.

Floodwater storage typically has occurred during late winter and early spring when vegetation is dormant, resulting in little damage to mature trees. Water level fluctuation does, however, prevent the establishment of

typical zones of vegetation along the lake edge. Winter pool fluctuations have resulted in ice damage to shrubs and small trees, thinning the understory of the shoreline woodland.

Increasing the pool elevation two feet for the development of a drought contingency pool would eliminate all existing vegetation in the increased area of inundation. In the lower pool this area would be minimal as the shoreline slopes are moderate to steep. In the upper pool area are meadow and turf areas which can normally tolerate short periods of inundation, but would be eliminated by prolonged inundation. The total area of proposed inundation is estimated to be increased from the present 21 acres to 25 acres. The long term impact to terrestrial vegetation would not be significant.

g. Effects on Wildlife.

Frequent flood control storage at Hop Brook Dam results in unpredictable water levels, and limits the growth of emergent vegetation for food and cover. This situation discourages waterfowl use of the lake. Suitable nesting and brooding sites can be found in the upper reservoir in vegetated wetlands along Welton, Wooster, Mashadock and Hop Brooks. These area would not be affected by the proposed increase in pool level.

Waterfowl species observed in the project area include mallard, canada goose, wood duck and black duck. Wildlife species prevalent in the project area include white tail deer, raccoon, woodchuck, eastern cottontail, muskrat, mink and ruffled grouse. There are no known Federally designated endangered wildlife species presently inhabiting the Hop Brook Lake area.

h. Historical and Archaeological Resources.

At least one recorded prehistoric archaeological site is reported near the edge of the permanent pool at Hop Brook Lake, and a high probability exists for presence of unrecorded sites within the project lands. Examination of historic period maps reveals at least one complete farmstead site and parts of two others dating from the 19th century or earlier below 325 feet NGVD. Present condition of these sites or of unrecorded sites which may exist is unknown.

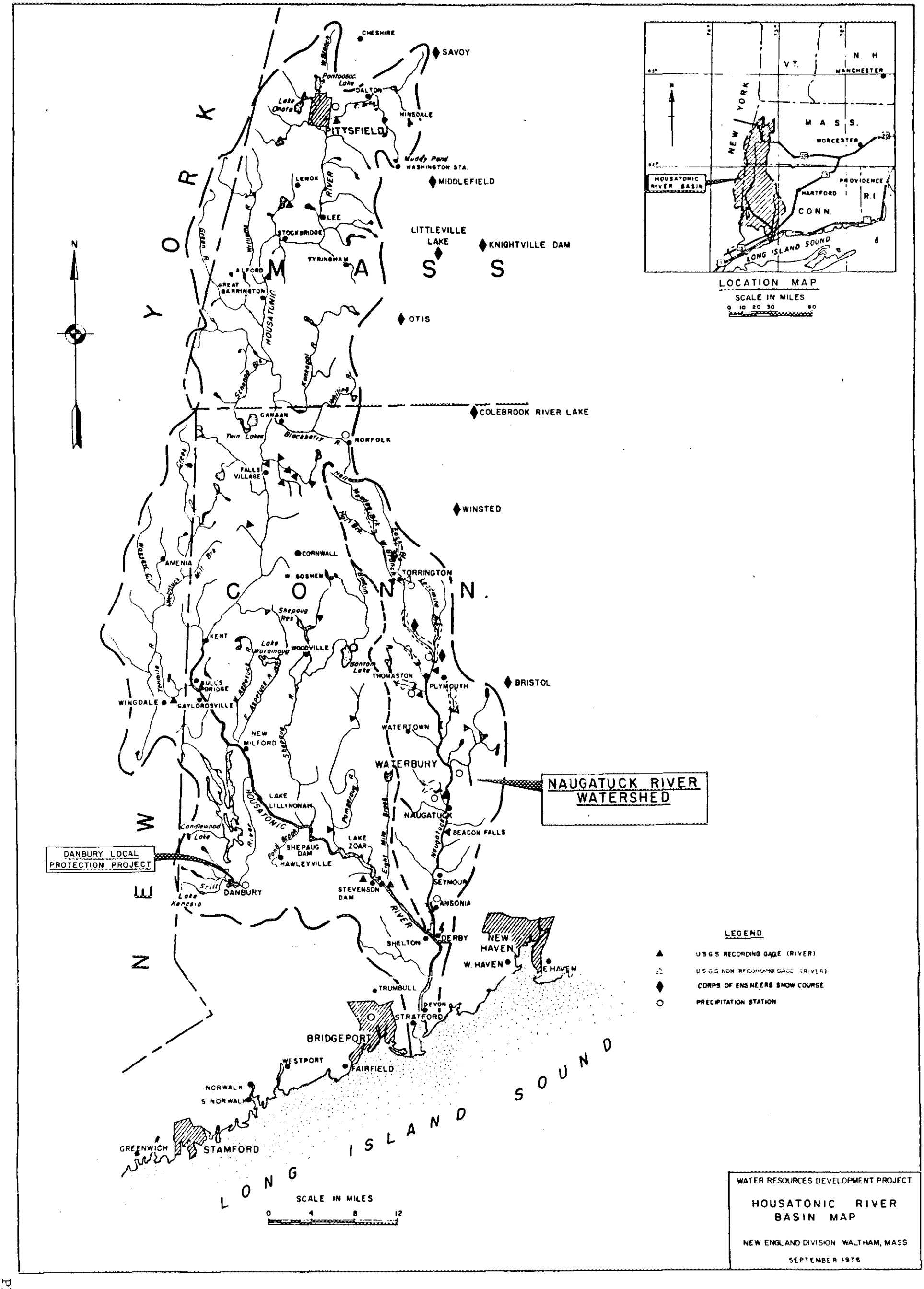
In order to comply with the requirements of the National Historic Preservation Act, an archaeological reconnaissance survey should be a part of any decision to

pursue drought contingency storage at the project.

11. SUMMARY AND CONCLUSIONS

It has been determined that a portion of the existing storage at Hop Brook Lake could be utilized for emergency drought purposes without having an adverse impact on the project's flood control functions. The water could be temporarily stored to an elevation of 312 feet. At this level, 2 feet above the permanent pool, it would be possible for the project to provide up to approximately 166 acre-feet (54 million gallons) of reservoir storage for drought emergency purposes. A cursory evaluation of the potential effects of this plan has revealed no significant adverse impacts to the project or the environment. A review for compliance with all current applicable environmental laws would be required at the time of any decision to pursue drought contingency storage at the project.

The water at Hop Brook Lake is of basically poor quality and is therefore unsuitable for public water supply. It would, however, be suitable for fire-fighting and irrigation.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DALTON
Lake Onota
HINSDALE
PITTSFIELD
Muddy Pond
WASHINGTON STA.
MIDDLEFIELD
LENOX
HOOSIC RIVER
LEE
STOCKBRIDGE
LITTLEVILLE LAKE
KNIGHTVILLE DAM
TYRINGHAM
ALFORD
GREAT BARRINGTON
HOUSATONIC
OTIS
COLEBROOK RIVER LAKE
CANAAN
Twin Lakes
Blackberry R.
NORFOLK
FALLS VILLAGE
WINSTED
CORNWALL
AMENIA
W. GOSHEN
TORRINGTON
Shepaug Res
KENT
Lake Waramaug
WOODVILLE
Bantam Lake
THOMASTON
PLYMOUTH
BRISTOL
BULL'S BRIDGE
WINGDALE
GAYLORDSVILLE
NEW MILFORD
WATERTOWN
WATERBURY
NAUGATUCK RIVER WATERSHED
LAKE LILLINONAH
NAUGATUCK
BEACON FALLS
Candlewood Lake
DANBURY LOCAL PROTECTION PROJECT
SHEPAUG DAM
HAWLEYVILLE
LAKE ZOAR
STEVENSON DAM
SEYMOUR
Still
DANBURY
Lake Kenosia
ANSONIA
DERBY
SHELTON
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W. HAVEN
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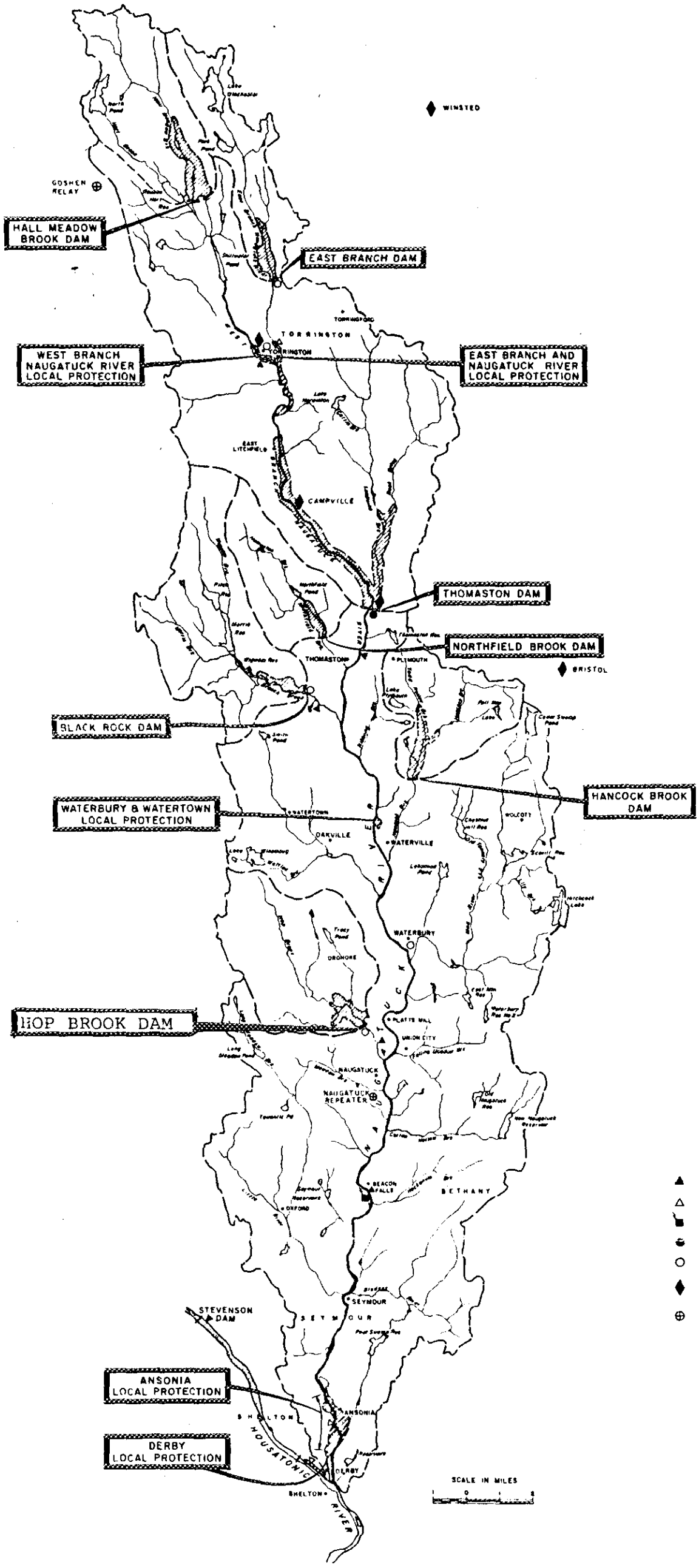
USGS NON-RECORDING GAGE (RIVER)
CORPS OF ENGINEERS SNOW COURSE
PRECIPITATION STATION
WATER RESOURCES DEVELOPMENT PROJECT
HOUSATONIC RIVER BASIN MAP
NEW ENGLAND DIVISION WALTHAM, MASS
SEPTEMBER 1976

PLATE 1

CORPS OF ENGINEERS

U.S. ARMY



LEGEND

- ▲ RECORDING GAGE (RIVER)
- △ NON-RECORDING GAGE (RIVER)
- TELEMARK GAGE
- RECORDING GAGE (RAINFALL)
- ○ NON-RECORDING GAGE (RAINFALL)
- ♦ SNOW SURVEY COURSE
- ⊕ AUTOMATIC HYDROLOGIC RADIO REPORTING NETWORK RELAY (CONTAINS RADIOS TIED DIRECTLY TO R C C COMPUTER ROOM)

WATER RESOURCES DEVELOPMENT PROJECT

HOUSATONIC RIVER BASIN

NAUGATUCK RIVER WATERSHED MAP

NEW ENGLAND DIVISION WALTHAM, MASS

SEPTEMBER 1974

PLATE 2

HOP BROOK LAKE
AREA-CAPACITY TABLE
DRAINAGE AREA = 16.4 SQUARE MILES

Stage (ft)	Elev. (msl)	Area (acres)	Capacity (ac/ft)	Capacity (inches)	Stage (ft)	Elev. (msl)	Area (acres)	Capacity (ac/ft)	Capacity (inches)
0	292	0	0	0	38	330	90	933	1.07
2	294	0	0	0	40	332	102	1,125	1.29
4	296	1	1	0	42	334	112	1,339	1.54
6	298	1	2	0	44	336	121	1,572	1.81
8	300	1	4	0.01	46	338	130	1,823	2.10
10	302	2	7	0.01	48	340	139	2,092	2.40
12	304	6	15	0.02	50	342	147	2,377	2.73
14	306	14	35	0.04	52	344	154	2,678	3.08
16	308	18	67	0.08	54	346	162	2,994	3.44
18*	310	21	120	0.12	56	348	169	3,324	3.82
18	310	21	0	0	58	350	180	3,672	4.22
20	312	25	46	0.06	60	352	190	4,042	4.64
22	314	28	99	0.12	62	354	205	4,437	5.10
24	316	31	158	0.18	64	356	220	4,862	5.58
26	318	35	224	0.26	66	358	232	5,314	6.10
28	320	39	298	0.34	68	360	244	5,790	6.65
30	322	48	385	0.44	70	362	257	6,291	7.22
32	324	58	491	0.57	72	364	270	6,850	7.80
34	326	68	617	0.71					
36	328	79	764	0.88			(Spillway Crest)		

*Recreation Pool

PLATE 3

PERTINENT DATA
HOP BROOK LAKE

LOCATION — Hop Brook, Waterbury and Naugatuck, Connecticut

DRAINAGE AREA — 16.4 square miles

STORAGE USES — Flood Control, Recreation

RESERVOIR STORAGE

	Elevation msl	Stage feet	Area acres	Capacity Acre-Feet	Capacity Inches on Drainage Area
Invert	292.0	0	0	0	0
Recreation Pool	310.0	18	21	120	.1
Spillway Crest	364.0	72	270	6,850 (net)	7.8 (net)
Maximum Surcharge	376.0	84	365	3,730 (net)	4.3 (net)
Top of Dam	381.0	89	---	-----	---

EMBANKMENT FEATURES

Type	Rolled earth fill, rock slope protection, impervious core
Length (ft)	520
Top Width (ft)	25
Top Elevation (ft msl)	381.0
Height (ft)	97
Volume (cy)	262,800
Dike	1 @ 400' Long, 33' High

SPILLWAY

Location	Saddle 1000' East of dam
Type	Uncontrolled, broad crested weir, chute spillway in rock
Crest Length (ft)	200
Crest Elevation (ft msl)	364.0
Surcharge (ft)	12
Design Head (ft)	12
Maximum Discharge Capacity (cfs)	23,000

OUTLET WORKS

Type	Rectangular conduit
Tunnel Inside Diameter (ft)	3' x 5'
Tunnel Length (ft)	425
Service Gate Type	Hydraulic slide
Service Gate Size	Two @ 3' x 4' high
Emergency Gate Type	None (stoplogs only)
Downstream Channel Capacity (cfs)	550+
Maximum Discharge Capacity at Spillway Crest Elevation (cfs)	600
Stilling Basin	31.5' x 14.0' wide, baffle blocks and end sill

RECREATION POOL

Length (ft)	2,200
Shoreline Length (ft)	8,660
Area (acres)	21

LAND ACQUISITION

	El. (ft msl)	Stage (ft)	Area (acres)
Fee Taking	364+300' Horiz. Strip	72	573
Easement	---	--	3
Clearing	312'	20	

MAXIMUM POOL OF RECORD

Date	29 January 1976
Stage (ft)	47.3
Percent Full	29

SPILLWAY DESIGN FLOOD

	Original Design (1964)
Peak Inflow (cfs)	27,400
Peak Outflow (cfs)	23,400*

*23,000 Spillway Discharge, 400 Conduit Discharge

UNIT RUNOFF

One Inch Runoff (acre-ft)	875

OPERATING TIME

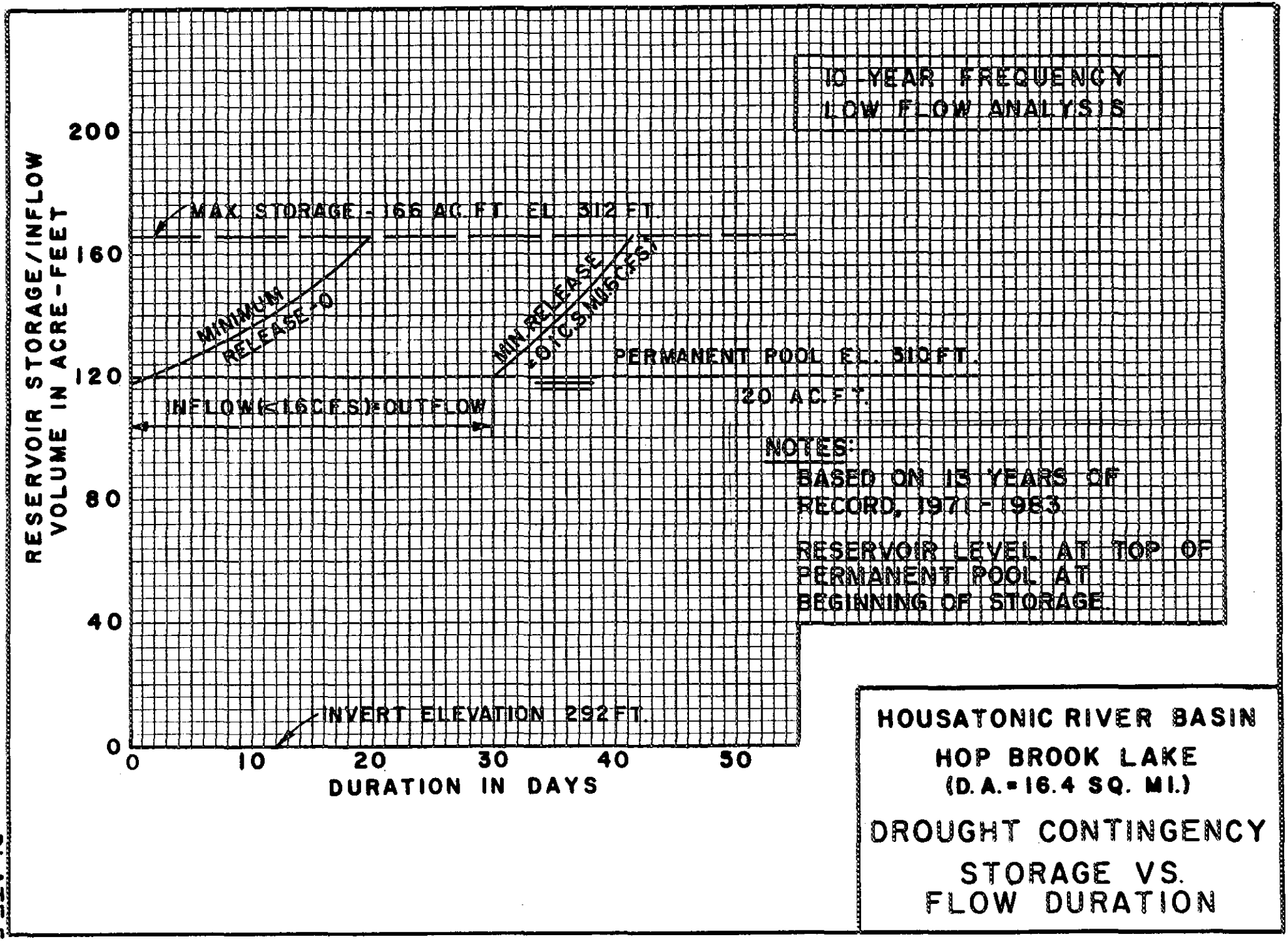
Open/Close all Gates	6 min. (Hydraulic Operation)

PROJECT COST (thru FY75) — $6,008,000

DATE OF COMPLETION — December 1968

MAINTAINED BY — New England Division, Corps of Engineers

PLATE 4



HOUSATONIC RIVER BASIN

HOP BROOK LAKE
(D.A. = 16.4 SQ. MI.)

DROUGHT CONTINGENCY
STORAGE VS.
FLOW DURATION

PLATE 5

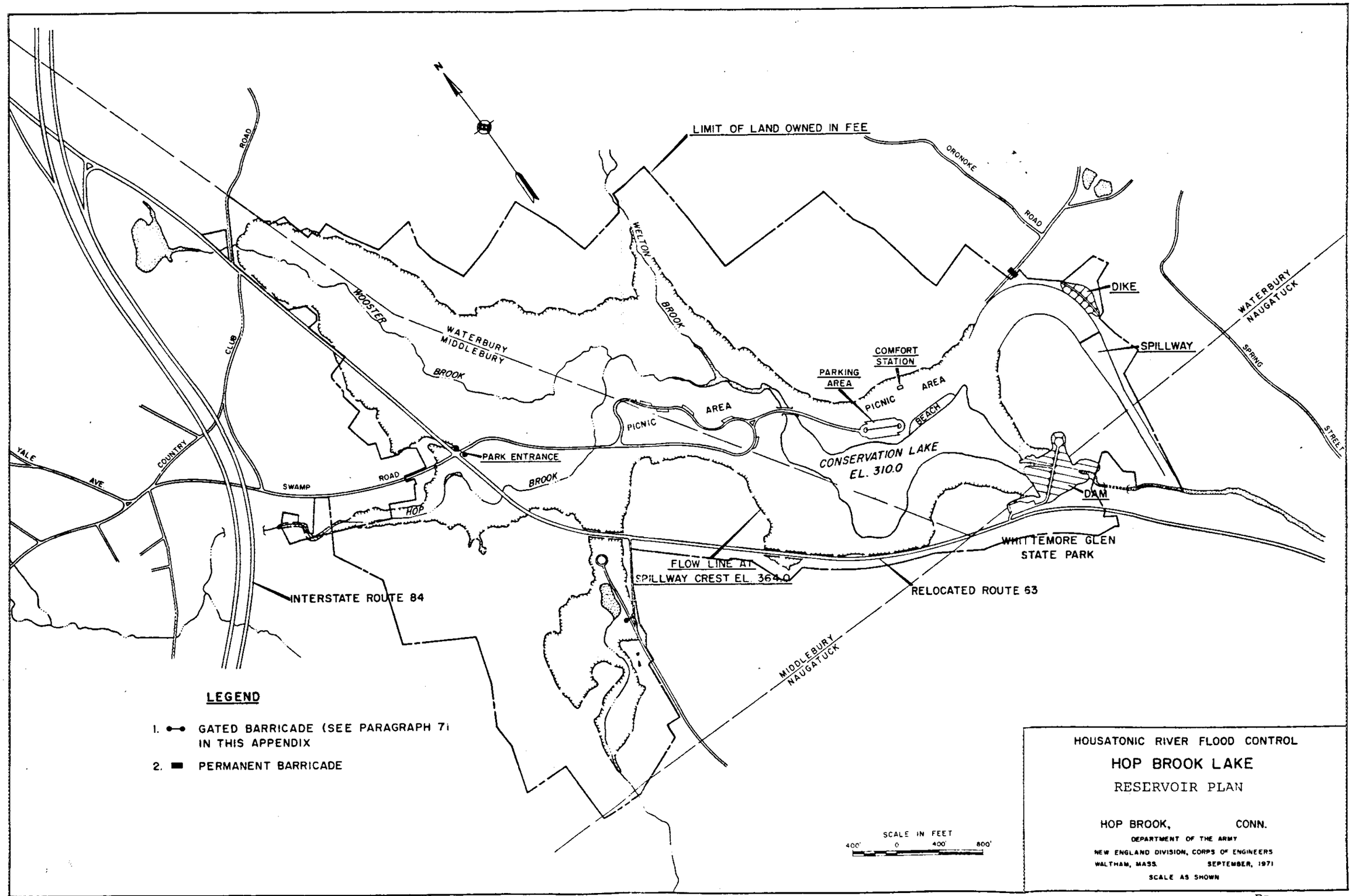

LIMIT OF LAND OWNED IN FEE
ORONOKE ROAD
WELTON BROOK
WOOSTER BROOK
WATERBURY MIDDLEBURY
BROOK
DIKE
SPILLWAY
WATERBURY NAUGATUCK
SPRING
STREET
COMFORT STATION
PARKING AREA
PICNIC AREA
BEACH
PICNIC AREA
PARK ENTRANCE
BROOK
CONSERVATION LAKE EL. 310.0
DAM
YALE AVE
COUNTRY CLUB ROAD
SWAMP ROAD
HOP
WHITTEMORE GLEN STATE PARK
FLOW LINE AT SPILLWAY CREST EL. 364.0
INTERSTATE ROUTE 84
RELOCATED ROUTE 63
MIDDLEBURY NAUGATUCK
LEGEND
1. GATED BARRICADE (SEE PARAGRAPH 7i IN THIS APPENDIX
2. PERMANENT BARRICADE
SCALE IN FEET
400' 0 400' 800'
HOUSATONIC RIVER FLOOD CONTROL
HOP BROOK LAKE
RESERVOIR PLAN
HOP BROOK, CONN.
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. SEPTEMBER, 1971
SCALE AS SHOWN

PLATE 6